AAE 590 – Spacecraft Attitude Dynamics
Spring Semester 2019

1. **Professor K. C. Howell (AAE)**
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2. **Teaching Assistants:**

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3. **Course Description:** The development of spacecraft rigid body equations of motion in terms of direction cosines, angles and quaternions, with external torques. Assessment of the attitude stability of the resulting rotational motion of the spacecraft. Stabilization techniques are ntroduced and the impact via numerical simulations. Introduction to attitude control.

4. **Prerequisites:** (AAE6), AAE 340 or equivalent
   senior level or equivalent

5. **Course Goal:** Equations governing rigid body motion and applied to spacecraft attitude orientation dynamics; leveraging fundamental attitude behavior as the basis for spacecraft attitude control.

   Specific Learning Objectives
   - Acquire and apply basic technical knowledge about vehicle orientation
   - Develop intuition about natural spacecraft attitude motion
   - Introduction to the dynamical basis for attitude control
   - Extensive computational analysis and interpretation of results
   - Communication of the analysis techniques and written interpretation of their own results
   - Explore spin stabilization of a satellite by designing a rotor to accomplish a specific stability objective

6. **Textbook: None required**
   Class notes and supplemental handouts will be available on Blackboard Learn. However, the notes and handouts are intended only to support the material presented in the lecture. Good lecture notes will be very important.

   Software: Software packages developed specifically for astrodynamics applications may be introduced. However, you will also be required to develop your own programs and/or MATLAB scripts.

7. Attendance: University Policy— *Students are expected to be present for every meeting of the classes in which they are enrolled.*

When conflicts or absences can be anticipated, the student should inform the instructor as far in advance as possible. For unanticipated or emergency absences, the student should contact the Prof Howell or a TA as soon as possible by email.

8. Problem Sets:

(a) Approximately one assignment per week.

(b) In preparing homework for submission, students are expected to use the format that will be discussed in class; papers should be neat and legible, ideas logically presented, and all papers stapled together. The use of calculators and/or simulations will be required during the semester.

(c) All homework assignments, i.e., problem sets, are due at the beginning of class. A ten-minute grace period is allowed for students who may be detained. Once class has started, the papers are submitted directly to the TA. Tardy papers are marked. Although late papers are graded for the benefit of the student, these late papers receive a score of zero.

(a) Graded papers are returned with a score. (The solutions are available in Blackboard.) If a student has a question about the score, **please write the question on a separate sheet of paper; submit both the questions and the original marked problem set to the TA.** We will assess the question and return the paper to the student with a response as soon as possible.

9. Academic Expectations: Collaboration

Adhering to high standards of academic integrity is an important part of your student experience. The standards are obvious when it comes to exams. For the homework problem sets, collaboration, such as working with others to conceptualize a problem, discussing approaches to the solution, or debugging code, is often a gray area, and faculty in different courses may have different approaches to this issue.

In this course, collaboration in terms of discussions is allowed since such discussions can be valuable to all students. Plagiarism, such as copying someone else's solution or MATLAB® code, is not allowed. The problem write-ups must always be your own. Modifying someone else's code to make it your "own" is also unacceptable. In case of doubt, consult the course instructor or the graduate TA.

10. Exams

(a) Three exams are scheduled during the semester on the following dates: 2/8, 3/27, 4/17. The final problem set will be assigned in lieu of a final exam.

(b) All students are expected to participate in the in-class exams to pass the class. If you are ill, the TA or instructor must be notified prior to the scheduled exam time via email. Professor Howell should receive a signed medical excuse before any make-up opportunity. Please see her as soon as you are recovered.

(c) It is expected that each student follows the exam procedures as detailed in class.

(d) For use of calculators on the exams, a **TI-30XIIS** or **TI-30XIIB** are the only calculators allowed.

11. Grades

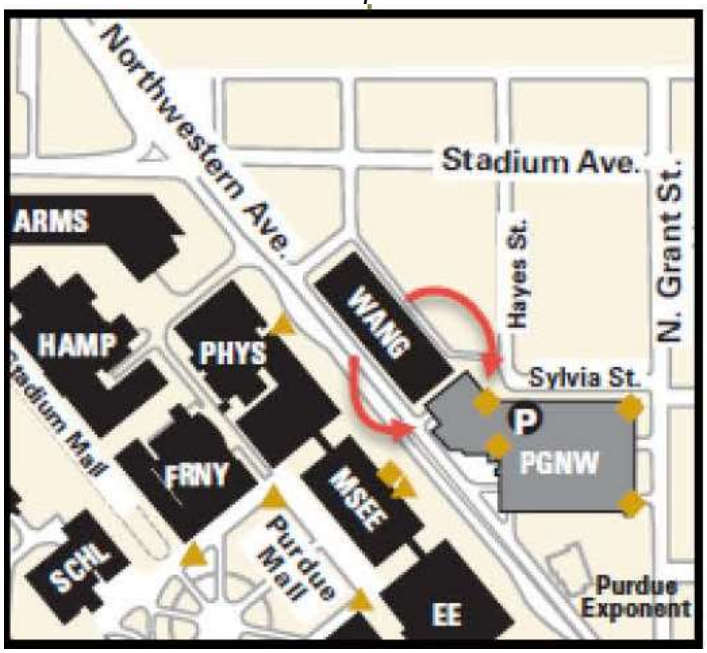
PS 30%
PS* 45%
Exams 25%

*Note: Over the course of the semester, HW assignments will include numerical simulations and interpretation of data. Satisfactory performance of these exercises is required to pass the course.

EMERGENCY PREPAREDNESS CLASSROOM BRIEFING

Emergency preparedness is your personal responsibility. Purdue University is continuously preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. It is good to review the following procedures:

- *To report an emergency, call 911.*
- *To obtain updates regarding an ongoing emergency, and to sign up for Purdue Alert text messages, view www.purdue.edu/ea*
- *There are nearly 300 Emergency Telephones outdoors across campus and in parking garages that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected immediately.*
- *If we hear a **fire alarm**, we will immediately suspend class, **evacuate the building**, and proceed outdoors, and away from the building. **Do not use the elevator.** Please gather in the Emergency Assembly Area (EAA) east of the Purdue University Student Health Center (PUSH) and west of Hampton Hall of Civil Engineering (HAMP) as indicated by the green safe-zone oval shown on the map below.*



- *If we are notified of a Shelter in Place requirement for a tornado warning, we will suspend class and shelter in the lowest level of this building away from windows and doors.*
- *If we are notified of a Shelter in Place requirement for a hazardous materials release, or a civil disturbance, including a shooting or other use of weapons, we will suspend class and shelter in our classroom, shutting any open doors or windows, locking or securing the door, and turning off the lights.*
- *Please review the Emergency Preparedness website for additional information http://www.purdue.edu/ehps/emergency_preparedness/index.html*